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TECHNICAL MANUSCRIPT 424

DESIGN, OPERATION, AND LIMITATIONS
OF A PERACETIC ACID SHOWER

Raymond V. Delorme

OCTOBER 1967

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DEPARTMENT OF THE ARMY

Fort Detrick
Frederick, Maryland

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DESIGN, OPERATION, AND LIMITATIONS
OF A PERACETIC ACID SHOWER

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October 1967

Technical Engineering Division
INSTALLATION AND SERVICES OFFICE

ABSTRACT

This manuscript describes the design, operation, and limitations of a peracetic acid shower and includes its architectural, piping, ventilation, electrical, and communication requirements. A description of the dressing and suit storage room and the characteristics of peracetic acid are included. A table shows the materials of construction for storage and handling of 40% peracetic acid. A schematic drawing of the piping is included, and the general construction of a peracetic acid sump is described.

I. INTRODUCTION

Peracetic acid (CH_3COOOH) is used as a decontaminant with limited application.* It decomposes to acetic acid and molecular oxygen, and the decomposition is hastened by an increase in temperature, especially if the acid is in contact with heavy metal ions such as iron (ferrous), manganese (manganic), and copper (cupric). Peracetic acid is a special-purpose decontaminant used at Fort Detrick to sterilize plastic protective suits for laboratory personnel. Such suits completely enclose the wearer and form a biological barrier between him and a highly infectious environment. Lines attached to the suit provide the wearer with air and a means of communication.

The acid decontaminant is corrosive, toxic, and very unstable. One acid shower is in operation at Fort Detrick, and limited information has been gathered on its use.

The acid shower stall is located at the exit of an area of a building where work is conducted with highly virulent microorganisms. It is large enough to accommodate one man wearing a plastic suit. The stall has two doors; one opens into the contaminated area, and the other into the dressing and suit storage room. The shower operates as follows: The suited man steps into the shower as he comes from the contaminated area. He connects his lines to the air and communication outlets in the stall secures all doors, and activates an automatic timer with a pull chain. The timer opens the hot and cold water solenoid valves for one minute. The timer then shuts off the water solenoids and opens the valve to a compressed air supply. The compressed air siphons 4% peracetic acid from a stainless steel storage tank and atomizes it over the suited person for 3 minutes. The solenoid on the acid vent line then opens and breaks the siphon, allowing the acid to drain from the pipe. The hot and cold water solenoid valves are then automatically opened for another minute to rinse the acid from the suit and remove some of the acid fumes. The compressed air stays on during this time to help ventilate the shower and remove residual acid from the lines. After the water wash, the suited man disconnects his air and communications lines, opens the door, and enters the dressing and suit storage room.

When entering the contaminated area the man dons the suit and enters the shower. He connects to the mask air system and enters the contaminated area. No showering is required.

* Trexler, P.C. 1958. The sterilization of clean protective clothing with peracetic acid and beta-propiolactone. *Bacteriol. Proc.* 35.

II. DESIGN

A. ARCHITECTURAL DESIGN

The shower room is 4 feet square inside; the perimeter of the floor has a 5-inch-high curb. A stainless steel (304) grill, located approximately 7 inches above the shower room floor, supports the person while showering. Under the grill a stainless steel (304) catch pan lines the shower floor and curb. The drain pipe protrudes approximately 4 inches into the pan, so that the acid is diluted before it enters the drain line. Details of the decontamination shower basin are shown in Drawing F-93-1-8000-1, sheet 13 of 22.

The interior walls of the shower are constructed of concrete blocks; the floor and ceiling are poured concrete. The walls and ceiling are painted to protect them from the peracetic acid. The concrete floor is not painted because the stainless steel catch pan covers it completely.

Two stainless steel hand rails are mounted on the walls as handholds for the person showering. They are about 2 inches in diameter and are mounted approximately 3½ feet above the support grill.

Doors are stainless steel and have port-type viewing windows 6 to 8 inches in diameter and about 5 feet above the bottom of the door. All doors are gasketed with 50-durometer BUNA-N and are water-tight. All door fixtures are stainless steel; each door has a crash bar for speedy exit in case of accident.

All openings around pipes, conduits, and ductwork through walls and ceiling into the shower are caulked with a silicone rubber sealant to prevent acid corrosion. The silicone rubber is not recommended for concentrated solutions of acid; however, we have had excellent results when used with our dilute 4% solution. Peracetic acid is extremely corrosive to some materials. Logical materials of construction for 40% peracetic acid are listed in Table 1.

B. PIPING

All pipe lines, pipe hangers, bolts, screws, fittings, etc. in the peracetic acid shower must be made of stainless steel (Fig. 1). The shower floor drain pipe up to and including the trap is constructed of stainless steel. The drain pipe extends 4 inches into the catch basin and has a fine-mesh screen tack-welded to its top. The extension retains the acid so that it is diluted before draining from the catch pan.

TABLE 1. MATERIALS^a FOR STORING AND HANDLING 40% PERACETIC ACID

Material		Recommended	Not Recommended
Glass	Pyrex	X	
Plastics	Polyethylene	X	
	Kel-F	X	
	Teflon	X	
	Polystyrene	X	
	Polyethylene-polyisobutylene	X	
	Saran	X	
	Koro-seal		X
	Vinylite		X
	Tygon		X
	Vinyls		X
Rubber	Natural		X
	Synthetic		X
	Silicone		X
Metals	316 Stainless Steel	Equip. Only Not Storage	
	Aluminum of 2S purity or higher	X	

a. F.M.C. Corporation, Inorganic Chemicals Division, New York 17, New York.
Bulletin No. 4.

Hot and cold water through a mixing valve provide a comfortable water temperature for the shower. Five stainless steel liquid-spray nozzles are located so as to provide maximum washing of suits. An emergency ball valve in the shower provides water directly from the cold water line in case of emergency; it also provides a means of manually operating the water rinse cycle in the shower.

Acid lines, acid vent lines, and the peracetic acid storage tank are all constructed of stainless steel. Compressed air siphons the acid from the storage tank and disseminates it through six pneumatic atomizers that are placed to insure maximum acid washing of the suit. The compressed air continues to flow even after the acid line is vented, in order to drain the lines and disperse the acid fumes. An emergency ball valve in the shower, which allows the compressed air to be turned on in case of emergency, provides a means of manually operating the acid wash cycle.

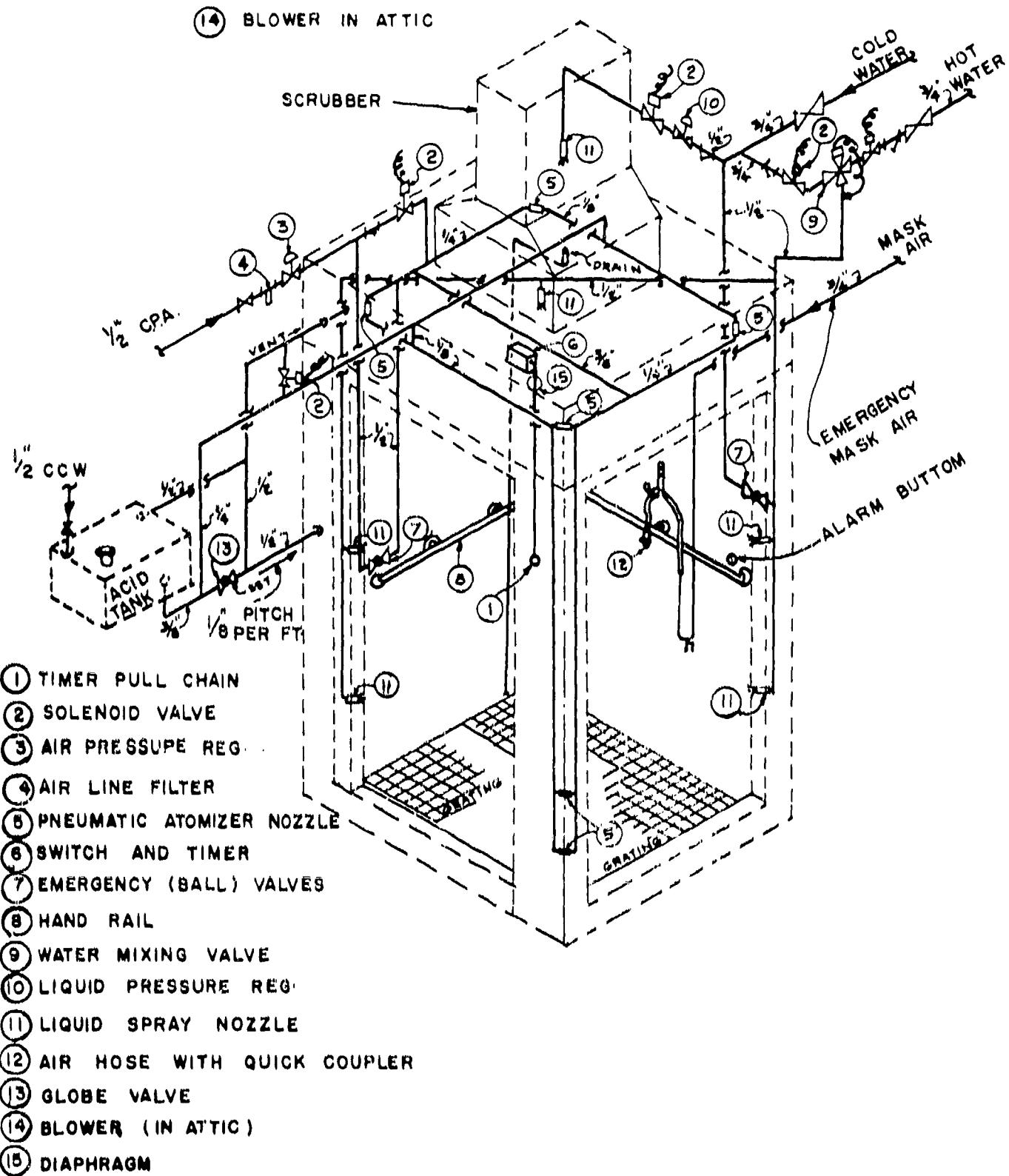


Figure 1. Peracetate Acid Shower Piping.

Oil-free compressed air (mask air) is piped into the acid shower for breathing and suit ventilation. One end of a rubber hose that is covered with BUNA-N connects to the stainless steel mask-air pipe. The other end of the hose has a stainless steel quick-disconnect coupler with a built-in shut-off valve. When the suited person enters the shower, he connects his air line to the quick-disconnect coupler. In case of a power failure or a pressure drop in the main mask-air line, a solenoid opens to cylinders containing an emergency air supply.

C. VENTILATION

Openings must be provided in the poured concrete ceiling of the acid shower to house the air scrubber and ventilation duct. All ductwork must be stainless steel or other suitable noncorrosive material, and all seams must be gas-tight. An air scrubber is installed at ceiling height to remove the acid fumes from the air before it is exhausted through the blower to the main ventilation plenum. The scrubber uses water sprayed from a nozzle over a series of baffles.

A blower with a peracetic acid - resistant coating ventilates the shower room. It draws air from the shower through the scrubber and discharges it into the exhaust plenum. The air in the shower room comes from the compressed air used to atomize the acid and provide suit ventilation. The blower has a greater capacity than the air available, so that the shower room is maintained at a negative pressure to contain the fumes.

D. ELECTRICAL AND COMMUNICATION REQUIREMENTS

A vapor-proof light is provided in the shower room. A vapor-tight alarm button is located near the end of one of the handrails to actuate a bell or buzzer in the dressing room in case of accident or emergency.

Because sterilization of the plastic suits requires a specified time exposure to the decontaminant, an automatic timer regulates the washing and rinsing cycles by actuating solenoid valves on the air, water, acid, and vent lines. A vapor-proof box around the timer prevents corrosion of contacts by acid fumes. The timer consists of six cams and six single-pole double-throw switches with a 6-minute stop cycle.

Personnel are completely enclosed in the plastic suits and require communication to other areas.

III. LIMITATIONS

The dilute 4% acid solution must be mixed daily because of rapid decomposition; the greatest limitation of the acid is its corrosiveness. The acid can be used only to decontaminate objects that are chemically resistant to it, so its use as a decontaminant is limited. Another major limitation is that a special area must be constructed for its use so that it can be contained. This presents many problems in selecting proper materials of construction. The acid shower is piped completely with type 304 stainless steel, which seems to be an excellent material for resisting corrosion by peracetic acid. The glazed ceramic tile walls were unaffected by the acid; however, the mortar between the tiles was eaten away in a few months. Rather than using the more expensive glazed ceramic tile it is recommended that a cheaper block be used and then painted with an acid-resistant paint.

IV. DRESSING AND SUIT STORAGE ROOM

The dressing and suit storage room is adjacent to the acid shower. It contains a bench for personnel donning or removing plastic suits, and an area with hooks for storing the suits. The shower is large enough to accommodate personnel, but not equipment. A large door must be available for easy access to the contaminated area when the room is sterilized to permit movement of equipment.

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